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The American STATISTICIAN

A publication of the
AMERICAN STATISTICAL ASSOCIATION

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Volume 2, No. 1

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The American STATISTICIAN

FEBRUARY 1948, Vol. II, No. 1

A publication of the
American Statistical Association.

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A NEW SECTION ON TRAINING IN STATISTICS

There is double significance in the steps taken at the Annual Meeting in New York last December toward the formation of a new Section on Training in Statistics.

For one thing, the timing, though more or less accidental, is noteworthy. The new Draft Constitution has just been submitted to the members for ratification. This constitution contains explicit provisions to encourage groups to develop specialized programs within the Association, so that diversity of interest and unity of the whole may be fostered at the same time. These provisions are a realistic recognition of the simultaneous need for the intense cultivation of special aspects of statistics and for mutual cooperation among special interest groups.

Now, even as this new constitution has been submitted for ratification, a group within the membership of the Association prepares to take advantage of these provisions. The proposal to form the new Section was made by one who has been very active in the Biometrics Section, the first Section of the Association, which may well become its first Affiliated Society. In all probability other Sections will develop in other content areas.

In the second place, this proposed Section is one more evidence of widespread concern for the improvement of training in statistics. The spontaneous proposal for the organization of the new Section arose toward the end of the second of two program sessions on the teaching of statistics. The enthusiastic response resulted in a hastily assembled meeting the next day which took the first step toward the organization of the new Section, of which W. Allen Wallis has agreed to act as chairman.

The general subject of training in statistics has been the topic of four reports which appeared during 1947. Two of these, the reports of the Committee on Applied Mathematical Statistics of the National Research Council and the Committee on the Teaching of Statistics of the Institute of Mathematical Statistics, have appeared in summary form in the October and December issues of *The American Statistician.* Two other reports, both prepared by a committee of the Inter-American Statistical Institute, will be summarized in the April issue. The present issue contains an abstract of a report of the Council of the Royal Statistical Society on the teaching of statistics in universities and university colleges.

The American Statistical Association's Committee on Training, of which Francis G. Cornell was chairman, has drawn up recommendations for a series of projects which it believes would immeasurably improve statistical training at all levels. The report of this Committee will appear in the report of the Annual Meeting, to be published in the March 1948 issue of the *Journal* of the ASA.

Because so much groundwork has already been done, the new Section is faced with a compelling and stimulating set of proposals for action. Some of these are long range projects requiring several years for completion. Some could not be undertaken without considerable resources. None could be accomplished unless there are members of the Association ready to give enthusiastic labor and creative imagination.

NEWS

107th Annual Meeting of ASA—Professional Societies elect new officers—Latin American News—New survey of consumer finances—OPA publishes War Profit studies

107TH ANNUAL MEETING OF ASA

The 107th Annual Meeting of the American Statistical Association was held at the Commodore Hotel in New York City on December 28, 29 and 30, 1947. The program was planned in conjunction with the programs of the American Sociological Society, the Institute of Mathematical Statistics, and the Biometrics Section of the ASA. About thirty separate meetings were held during the three days, with major emphasis on the application of statistics to particular fields, such as population, international problems in health and vital statistics, industry statistics, statistics as used by life insurance companies, the teaching of statistics, etc. Return to the pre-war practice of a major session on economic forecasting attracted a great deal of interest.

The Association's Committee on Graphics presented a new and expanded display of charts and graphic publications. This display is the basis of a permanent exhibit which will be maintained by the ASA. It was first presented at the meetings of the International Statistical Institute in Washington in September 1947.

Of particular significance was the formation during the sessions of a new section of the ASA on training in statistics which is discussed in the editorial on page 1 of this issue. At two sessions the topic of training was discussed very fully. Dr. Snedecor of Iowa State College presented a stimulating paper outlining a syllabus of a proposed course of basic statistics: and various reports on training, including those prepared by the Inter-American Statistical Institute, were summarized.

A resolution proposing a longer range plan for meetings and programs of the ASA in conjunction with other social science groups was presented at the annual business meeting. Similar resolutions were presented at the annual meetings of other groups. It was announced that the annual meetings in 1948 will be held at the Hotel Statler in Cleveland during Christmas–New Years week.

The detailed proceedings of the 107th Annual Meeting will be published in the March issue of the *Journal of the American Statistical Association.*

Biometrics Section meeting on March 15

The Biometrics Section of the ASA will hold a joint meeting with the American Pharmacological Society in Atlantic City on March 15–19, 1948.

1948 OFFICERS ELECTED

Institute of Mathematical Statistics

President—Abraham Wald; Vice-Presidents—Churchill Eisenhart and Henry Scheffe.

The Econometric Society

President—Charles F. Roos; Vice-President—Ragnar Frisch, University of Norway; Secretary and Treasurer—Alfred Cowles, University of Chicago; Council—R. G. D. Allen, London School of Economics; C. Bresciani-Turroni, Banco di Roma; Colin Clark, Brisbane, Australia; J. R. Hicks, University of Oxford; Simon Kuznets, University of Pennsylvania; Oscar Lange, New York; Jacob Marschak, University of Chicago; Giorgio Mortara, Rio de Janeiro, Brazil; Joseph A. Schumpeter, Harvard University.

The American Economic Association

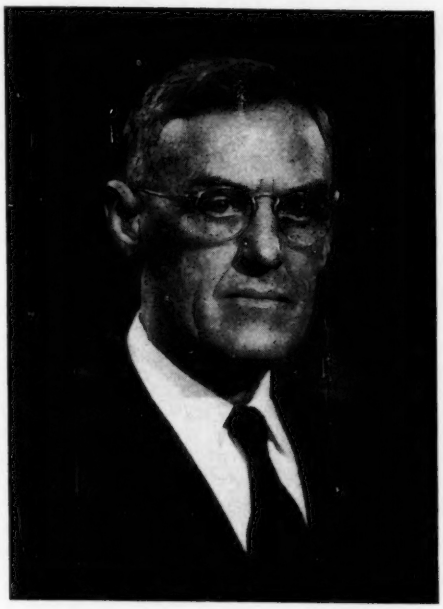
President—Joseph A. Schumpeter, Harvard University; Vice-Presidents—Morris A. Copeland, Federal Reserve System, Simeon E. Leland, Northwestern University; Elected Members of the Executive Committee—Seymour E. Harris, Harvard University, Clair Wilcox, Swarthmore College, Ben W. Lewis, Oberlin College, Arthur R. Upgren, University of Minnesota, Bernard F. Haley, Stanford University, Richard A. Lester, Princeton University; Secretary-Treasurer, James Washington Bell, Northwestern University.

Biometrics Section of the ASA

Chairman—Joseph Berkson, Mayo Clinic; Secretary—John H. Watkins, Yale University School of Medicine; Section Committee—Philip J. Rulon, Harvard University; Margaret Merrell, Johns Hopkins University; John W. Tukey, Princeton University; D. J. Finney, Oxford University.

The American Sociological Society

President—E. Franklin Frazier, Howard University; First Vice President—Robert C. Angell, University of Michigan; Second Vice President—Herbert Blumer, University of Chicago; Secretary-Treasurer—Ernest R. Mowrer, Northwestern University.



GEORGE W. SNEDECOR

Professor George W. Snedecor, of the Statistical Laboratory at Iowa State College, was elected President of the American Statistical Association for 1948 at the annual meeting of the Association in New York, December 1947.

ASA ELECTS NEW OFFICERS AND FELLOWS

OFFICERS:

George W. Snedecor, President
Willard L. Thorp, Director, 1948–1950
Frederick F. Stephan, Director, 1948–1950
A. Ford Hinrichs, Vice-President
Rensis Likert, Vice-President
Abraham Wald, Vice-President
Harry R. Wellman, Vice-President

FELLOWS:

John Hamilton Curtiss
Milton Gilbert
Morris H. Hansen
William N. Hurwitz
Jacob Marschak
Herbert Marshall

He succeeds Willard L. Thorp, Assistant Secretary of State for Economic Affairs.

Professor Snedecor organized the Statistical Laboratory in 1933 and was its Director until last July. His time is now devoted to teaching and research. He is joint author with Henry A. Wallace of "Correlation and Machine Calculation" and is the author of "Analysis of Variance and Covariance" and "Statistical Methods Applied to Experiments in Agriculture and Biology". He is a Fellow of the American Statistical Association, the American Association for the Advancement of Science and of the Institute of Mathematical Statistics. He served as a Vice-President of the ASA in 1947.

United Nations Sub-Commission on Statistical Sampling

The Sub-Commission on Statistical Sampling reviewed the use of sampling methods in various countries which have considerable experience in this field, adopted a series of general recommendations on applications of sampling, and drew attention to the need for extension of training in sampling theory and practice.

In connection with the 1950 Census of Agriculture specific problems in the use of sampling were considered, and the Sub-Commission recommended that as an integral part of this program, properly planned sample surveys should be attempted in as many countries as possible.

Sampling methods in family budget inquiries and national income studies, sampling to be used for population characteristics, and sampling in relation to economic planning were also given consideration.

A limited number of copies of the final report of the Sub-Commission (E/CN.3/37) are available from the Statistical Office, Lake Success, New York.

Alabama Polytechnic Institute

Professor George W. Snedecor, President of the American Statistical Association and Research Professor of Statistics at Iowa State College, will be visiting Research Professor of Statistics at Alabama Polytechnic Institute during the Spring Quarter, from March 22 to June 4, 1948. He will lecture on Experimental Design and be available for statistical consultations. Conferences in applied statistics for research workers in the area are scheduled during Dr. Snedecor's visit.

Junior statistician wanted

The Institute of Paper Chemistry, Appleton, Wis., is seeking a Junior Statistician, B.S. or M.S. The Institute is a graduate school; its staff further does experimental work for the paper industry. Statistical method is applied both to the problems of experimentation and to those of mill operation. Application for appointment should be addressed to Dr. Geoffrey Beall.

1948 Survey of Consumer Finances

The University of Michigan Survey Research Center will do its third national sampling study of post war income and expenditures for the Board of Governors of the Federal Reserve System. The survey will follow the general pattern of those conducted in 1946 and 1947 and will continue the use of the "spending unit" rather than the "family unit" as the basis for its interviews, tabulations, and analyses. Some changes have been made in the interviewing procedure to permit combination of the "spending unit" data and the "finding unit" data. The interview schedule calls for the following information: liquid assets at the time of interview; income and savings in 1947; changes in liquid asset holdings during 1947; changes in income and amount saved in 1947 compared with 1946; actual expenditures for consumer durable goods and houses in 1947, and a method of payment. The schedules also call for information on: expectations for major expenditures in 1948, use of liquid assets, and rates of saving. Results of the survey will probably be available by early summer.

Dept. of Agriculture Committee on Experimental Design examines statistical techniques

The Department of Agriculture is promoting experimental planning and use of statistical techniques in research through its Experimental Design Committee. Activities have included meetings for discussion, consulting service to any experimenter wanting help, and development of short discussions concerning requirements for experimental work.

The committee includes S. B. Detwiler, Jr.; G. E. Holm; E. E. Houseman, Secretary; Sophie Marcuse; J. G. Osborne; O. A. Pope; R. G. Schott; H. M. Tysdal; F. M. Wadley, *Chairman.*

Summer Sessions at the University of California

The University of California will offer statistical programs in two summer sessions in 1948. Courses in statistics will be offered at both graduate and undergraduate levels. The graduate courses are given during the summer session from June 21 to July 31 and are meant primarily for students who have already obtained their Ph.D. degree or are working towards it. The second summer session will be held from August 2 to September 11.

The teaching staff is: Raj Chandra Bose, Professor of the University of Calcutta, India; Miss Evelyn Fix, Lecturer at the University of California, Berkeley; Erich L. Lehmann, Assistant Professor of the University of California, Berkeley; Michel Loeve, Reader at the University of London, England; Jerzy Neyman, Professor of the University of California, Berkeley; Abraham Wald, Professor of Columbia University, New York.

American Society for Quality Control offers Washington, D. C. programs

The Washington section of the ASQC has held a series of meetings dealing with "What Should a Specification Contain", "Binomial Probability Paper and Applications", "Applying Quality Control to Heavy Industry", "Statistical Quality Control and the Influence Fuze Program". Statisticians interested in future meetings should get in touch with A. L. Robertson, Secretary-Treasurer, 8453 Piney Branch Court, Silver Spring, Md.

Latin American News

ARGENTINA—In preparation for the fourth national census, President Peron has divided the *National Office of Research, Statistics and Censuses* into two sections, one technical and the other administrative. The technical office will be in charge of all census taking and mathematical computation. BRAZIL—*The National Census Service* has recently published two synopses of general data and about 500 analyses of the demographic census taken in 1940. The volume will be available during the coming year. *The Brazilian Statistical Society* recently held a contest and awarded prizes for "Elementary Lessons in Statistics" by Joao de Mesquita Lara, and "The Logistic Law and its Application to Brazilian Population Growth" by Jorge Kingston. COSTA RICA—Thomas F. Corcoran has just reported to the government of Costa Rica on the present status of its statistical services and recommended the creation of a *National Council of Statistics* which would coordinate municipal, provincial and semi-official statistics but leave administrative responsibility decentralized. He also proposed a plan for the organization of a 1950 census of population and agriculture which would provide for a separate census office. CHILE—The General Bureau of Statistics has organized an *Institute of Statistical Research.* The Institute includes a committee on the coordination of national and international statistics, which is at present working with fiscal and municipal statistics. It also has a committee on censuses now working on plans for the 1950 Census of the Americas, and the agricultural and live stock census which is to be taken in 1948. MEXICO—The *General Bureau of Statistics,* a part of the Ministry of National Economy, has been organized to supervise the statistical work of other government agencies, local governments, and private institutions. It is charged with the promotion of statistical development in the Republic, with particular emphasis on teaching and methodology: with planning statistical exhibits, national statistical meetings and the establishment of a socio-economic museum. The DOMINICAN REPUBLIC—has created a *National Council of Statistics* as part of the General Bureau of Statistics to be in charge of all statistical services of the government. URUGUAY—*An Advisory Committee on the National Census* has just been created for the purpose of drafting a law providing for a national census to coincide with the 1950 Census of the Americas.

Needs for Labor Statistics from the U.S.S.R.

An article by Will Lissner appearing in the *New York Times* of December 21, 1947, touched off a controversy concerning the economic statistics available for the U.S.S.R. Mr. Lissner published an analysis of some of the recently announced retail prices for the U.S.S.R. as compared with New York City prices for the same or similar goods in terms of the man hours of work required to pay for them by the average wage earner. The wage data used in this analysis both for the U.S.A. and the U.S.S.R. came from the Bureau of Labor Statistics. The figure used for the U.S.A. was average hourly earnings in all manufacturing industries; that for the U.S.S.R. an estimate of hourly earnings based on a statement in the translation of the Fourth Five-Year Plan published by the Embassy of the U.S.S.R. in Washington and on statements in other Russian publications.

Two Soviet citizens protested Mr. Lissner's figures, and the *Times* requested B.L.S. to make a critical analysis of the data he used and his conclusions. The B.L.S. analysis released by Ewan Clague, Commissioner of Labor Statistics, said in part:

"Of the (*Times*) comparison as a whole (of the hours of work required to buy certain essential consumers' goods in the U.S.A. and the U.S.S.R.), it can be said that it gives as close an approximation to the order of magnitude of the difference between the new Soviet prices on the announced price schedule and prices in the United States as can be obtained from the data currently available.

"However, the Soviet Union has not published any comprehensive wage statistics since 1938. The dissemination of specific information in regard to the economic situation of all the countries of the world will promote international understanding. But if this is to be accomplished, it is necessary that adequate information be made available by the statisticians of each country.

"The extensive reports on wage rates and earnings made by the United States Bureau of Labor Statistics are readily available to the Soviet public, but the wage data available for the Soviet Union are so fragmentary that no precise understanding of the Soviet wage situation is possible in this country."

Spanish speaking teachers of statistics needed in Latin America

There is an increasing demand for North American Statisticians to teach economics and statistics in Latin American universities. Statisticians with a command of Spanish who accept positions as teachers will have an opportunity to serve as consultants on community projects, as well as find time for independent research.

A register of interested persons will be maintained at the Office of the Secretary, American Statistical Association, 1603 K Street, N. W., Washington 6, D. C.

Hippocratic Oath for Social Sciences

In his presidential address on "The Role of Science in our Unique Society," delivered in Chicago as the retiring president of the American Association for the Advancement of Science, James Bryant Conant of Harvard University proposed that scholars studying man and his society might well join together and issue a proclamation similar to the doctor's Hippocratic oath, setting forth their ideals and goals for American society.

American Association for Public Opinion Research formed

Two public opinion research groups were formed at the World Congress on Public Opinion Research, held at Williamstown, Mass., in September. The American Association for Public Opinion Research elected as its officers: Clyde W. Hart, Director of the National Opinion Research Center, President; Elmo C. Wilson, Research Director of the Columbia Broadcasting System, Vice President; and Julian L. Woodward, with the firm of Elmo Roper, Secretary-Treasurer.

The autonomous Committee for Public Opinion Research and World Peace was also organized at this time with Theodore F. Lentz of Washington University as Chairman. Its membership includes twenty-three representatives of seven nations.

New Listing of 874 Standards available

free of charge at the American Standards Association, 70 East 45th Street, New York 17, N. Y.

Jacob Wertheim Fellowships in Industrial Relations Offered by Harvard University

Applications will be received up to June 1, 1948, for the Jacob Wertheim Fellowships in the field of industrial relations. These Fellowships are awarded to applicants submitting a program of research in the field of industrial cooperation which may normally be expected to result in publication.

The awards are made for a year but may be renewed for a second year in exceptional circumstances. The awards may vary from $500 to $4000 or even more depending on the scope and nature of the undertakings and the expenses involved. Provision is also made for the publication of the research. Residence is normally expected in Cambridge, Massachusetts.

Any mature man or woman with expert knowledge or experience in the field of industrial relations may apply. A university degree is not requisite.

Applications should be filed with the Wertheim Committee (Professor John D. Black, Chairman, 205 Littauer Center, Harvard University, Cambridge, Massachusetts).

[Continued on page 22]

Planning for the 1950 Censuses of Population and Agriculture

by A. ROSS ECKLER
Bureau of the Census

During the war one of the phrases commonly used to emphasize the need for action was "It is later than you think". This phrase is being put to many peacetime uses and currently can be very properly applied to planning work for the 1950 Censuses of Population and Agriculture,[1] even though it is still more than two years before the house-to-house canvass begins.

During the past six months, periodic meetings have been held by the staff of the Bureau of the Census to reach certain tentative decisions regarding the basis for budgeting and for advanced geographic work as well as other subjects requiring particularly early consideration. In addition, several meetings of the Census Advisory Committee of the American Statistical Association have been devoted in considerable part to problems connected with the Decennial Census. Through the efforts of the staff planning group, a time table has been drawn up showing the dates at which each of the many preparatory operations required for the 1950 Census should be completed. Some of these dates, of course, can be shifted appreciably without serious loss, but a number of them are quite inelastic.

Perhaps the most rigid of the requirements governing the planning work is that connected with the preparation of budget estimates. In the summer of 1948 the Bureau staff will need to make detailed estimates for the complete Censuses of Population and Agriculture. These estimates will be reviewed by the Department of Commerce in the latter part of the summer of 1948, by the Bureau of the Budget in the early fall, and by the appropriate Congressional committees in the early part of 1949. The estimates are of course based upon specific assumptions regarding the questionnaires to be used, the field organization and training program, the types of tabulations to be made, and the publication program. Once the estimates have been submitted, the total amounts requested must be regarded as absolute ceilings which cannot be exceeded, unless some development like a general pay raise would permit the agencies to submit supplemental appropriation requests. Consequently, after the budget estimates have been submitted, any proposals for the inclusion of a new feature in the Census of Population or Agriculture that involves additional outlay can be considered only if offsetting economies can be effected.

Another important aspect of Census planning involving considerable rigidity is the preparation of maps and other material for enumeration. The preparation of the nearly 1,000,000 maps needed for field control is more than a two-year job for which definite time schedules must be maintained. This means that geographic areas for which statistics are to be shown, such as census tracts or metropolitan areas, must be determined well in advance so that their boundaries can be placed on the maps from which the separate enumeration areas are set up.

Growing demand for census data

The staff of the Census Bureau recognize that the wide-spread use of census statistics imposes unusual responsibility upon them to develop a program to take account of all types of demands. Insofar as possible, they should become acquainted in the next three or four months with all the requests for new types of population and agriculture data and new types of tabulations. They should determine the feasibility of meeting the new demands and should plan budget requests in such a way as to meet those demands possessing sufficient public interest and usefulness. The staff should not only review the importance of the new demands but should continually examine the need for repeating the inquiries used in earlier years. In other words, no subject should be included in the 1950 Census merely because it was a part of one or more previous censuses.

Anyone who is familiar with Census statistics or, for that matter, with almost any type of survey statis-

[1] This statement is being restricted to the Censuses of Population and Agriculture, since under the provisions of legislation now being considered by the Congress the Censuses of Business, Manufactures, and Mineral Industries, hitherto included as part of the decennial census program, would be placed on a quinquennial basis and be taken in the years ending in 3 and 8 (presumably with some modification of dates for the Censuses of Business and Mineral Industries prior to 1950).

ties, whether public or private, knows the strong pressure that always arises in behalf of new questions. In support of the demand, it is pointed out that a particular question adds little to the cost since the enumerator has already made his contact with the household and needs only a very short additional time to get one more question answered. There is a certain amount of truth in this contention although it should be noted that the prolongation of the interview time does add something to the cost and may prolong the interview time to a point where fatigue and annoyance on the part of the respondent affect the quality of the answers.

Another serious consideration, and one not so generally recognized, is the deterioration in the quality of all the census results arising when an unduly heavy load is imposed upon an army of quickly recruited and often inadequately trained enumerators. Each question added to the schedule contributes its share to the volume of instructions which need to be assimilated in advance of enumeration, and the cumulative effect of a large number of additional questions may be to spread the training time over so many subjects that the enumerator is not properly equipped to get reliable information on any one of them.

Further, if the new questions are not fully accepted by the public, popular resentment may develop and the accuracy of answers to other questions may thus be affected. It should be noted also that the addition of questions to the census schedule increases proportionately the time required to review and edit the information in the Washington office, to enter codes where necessary, to prepare punch cards and to tabulate, summarize, and publish. As a result of delays at all these points, some of the census results become available in published form two to three years after the date to which they apply, with the result that their value is appreciably reduced.

Application of sampling

It is important that planning for the Censuses of Population and Agriculture be made with full regard for the potentialities of sampling as a means of meeting some of the needs for statistical information. Not only can some questions be limited to a sample of households, but also some tabulations of items collected from all persons can be made on a sample basis, either to give early returns or to reduce the costs for certain detailed tabulations needed only for very large areas. Through the use of a sample of 5 percent of the population (or even less) it is possible to provide figures for large cities and for most States.

When the requirements of users are rigorously examined, it will be found that by no means all the questions in the population census need to be covered on a 100 percent basis. It is necessary, of course, to have the population count on a complete basis because of its use for apportionment and other official purposes and it is necessary also to have complete coverage for those types of data that need to be reported for very small areas such as census tracts, the smaller counties and the smaller urban places and minor civil divisions. For these very small areas only an extremely large sample would suffice to provide reliable data and such statistics as are necessary for these areas can be feasibly provided only through complete coverage. Fortunately, however, most of the population statistics required for these small areas are relatively simple and the number of questions needed to meet them is not large. The case with regard to needs for complete coverage is somewhat different in agriculture, because of the very large number of crops and their irregular distribution.

It should be noted that the use of a sample does not avoid all of the difficulties arising from increasing the number of questions included in the census. It does, of course, decrease the interview time for the average household and correspondingly cuts down the office work required for a majority of the schedules. However, the burden upon the enumerator is not decreased and is even increased because he must learn the rules for the inclusion of sample households. Of course the sample might be designed so that only a limited number of enumerators would use the sample questions but such a procedure would decrease the dispersion of the sample and correspondingly its efficiency. Also, theoretically the sample questions might be covered in a separate interview conducted by a specially trained set of enumerators, but this procedure would add considerably to the cost and would involve certain public relation problems. Consequently, at this stage it does not appear feasible to depend upon sampling by itself as a means of reducing the training burden upon the field organization.

Methods of getting advice regarding the censuses

The Bureau of the Census has always regarded itself as responsible for securing data which will be most useful to the individuals and organizations using its product. To meet this responsibility the Bureau must solicit the opinions of its users. The current need for this kind of activity is unusually great for several reasons: (1) The pressure for new questions and tabulations will be increased because of unusual wartime

shifts and because of the general expansion in the private and public uses of factual data. (2) There is need for the greatest possible economy, especially in view of the sharp increase since 1940 in many types of costs connected with census taking. (3) There is need to consider new techniques since the continued high mobility of the population and the large numbers in hotels, rooming houses, dormitories, trailer camps and other places difficult to enumerate will make for unusual difficulty in obtaining a satisfactory population count. (4) There is a need for improving the quality of census statistics.

The Bureau of the Census will rely heavily upon the judgment of technical and advisory committees in assigning proper weight to the many conflicting claims for consideration. As in the past the Census Advisory Committee appointed by the President of the American Statistical Association will serve as the final clearing house for the recommendations from all the more specialized committees. The present membership of this committee is as follows:

William F. Ogburn, (Chairman), University of Chicago; Murray R. Benedict, University of California; Donald R. G. Cowan, Donald R. G. Cowan and Associates; J. Frederic Dewhurst, Twentieth Century Fund; Frederick F. Stephan, Princeton University; Willard L. Thorp, Assistant Secretary of State; Ralph J. Watkins, Dun and Bradstreet, Inc.

A member of this committee will be invited to participate in the meetings of each of the technical committees listed below so that he may know the considerations which led to the adoption of each recommendation and may be able to present these considerations to the main committee.

Special committees set up by the Census Bureau

The chief advisory committee dealing specifically with the Census of Agriculture will be the Special Census Advisory Committee on the 1950 Census of Agriculture which was established in the fall of 1947 and met for the first time on October 27, 1947. This Committee will make recommendations as to the need for proposed inquiries for the 1950 Census of Agriculture and as to the form in which the statistics are to be published. The membership of this Committee is as follows:

J. T. Sanders, (Chairman), the National Grange; Victor Hawkins, Agricultural Publishers Association; T. K. Cowden, American Farm Bureau Federation; Russell Smith, Farmers Educational and Cooperative Union of America; John J. Riggle, National Council of Farmer Cooperatives; L. M. Walker, Jr., National Association of Commissioners, Secretaries and Directors of Agriculture; John F. Timmons, American Farm Economic Association; M. R. Benedict, University of California; Foster F. Elliott, U. S. Department of Agriculture.

Much of the spade work for the 1950 Census of Agriculture will be performed by committees of government statisticians. A joint committee comprising representatives of the U. S. Department of Agriculture, the Bureau of the Census and the Bureau of the Budget has been established and a series of working subcommittees has been set up. These subcommittees are working on three series of problems—(a) problems involving definitions and classifications, (b) problems involved in securing adequate enumeration and (c) problems concerned with seeing that the needs of the users of census data are adequately planned for in the tabulating and publication program.

Problems involving definitions include the definition of a farm, whether specialized operations such as hatcheries, fur farms, nurseries, etc. should be considered as farms, the enumeration of croppers in the South, the inclusion of public owned lands in farms in the West, etc. Problems relating to adequate enumeration pertain to plans for the enumeration and checking the enumeration of large farms and enumeration of farms on which the operator has changed during the year preceding the census. The problems concerned with the relationship of needs of users and the tabulation and publication programs comprise the economic classification of farms, the form of publication of farm tenure data for the South, and related subjects.

In connection with planning the Population Census three separate technical committees are being set up. The first of these committees will deal with general population problems; the second with economic statistics from the Population Census (labor force, occupation and industry, income, etc.); and the third committee will consider housing statistics.

TECHNICAL ADVISORY COMMITTEE ON GENERAL POPULATION STATISTICS IN THE SEVENTEENTH DECENNIAL CENSUS: Harry Alpert, Harold F. Dorn, Margaret J. Hagood, Philip M. Hauser, A. R. Mangus, Thomas C. McCormick, Frank W. Notestein, Samuel A. Stouffer, Conrad Taeuber, Rupert B. Vance, Pascal K. Whelpton, Frederick F. Stephan. TECHNICAL ADVISORY COMMITTEE ON ECONOMIC STATISTICS IN THE SEVENTEENTH DECENNIAL CENSUS OF POPULATION: Roe Alderson, John C. Davis, John D. Durand, Kathryn Ellickson, Martin Gainsbrugh, Meredith

Givens, Hildegarde Kneeland, Howard B. Meyers, Gladys L. Palmer, Margaret Scattergood, Paul Webbink, J. Frederick Dewhurst. TECHNICAL ADVISORY COMMITTEE ON HOUSING STATISTICS IN THE SEVENTEENTH DECENNIAL CENSUS: Malcolm B. Caplin, Miles Colean, Max Wehrly, Ernest M. Fisher, F. Stuart Fitzpatrick, Shirley K. Hart, Paul Krueger, Richard U. Ratcliff, Allan A. Twitchell, Warren Vinton, Wilson Wright, Ralph J. Watkins.

In addition to these specifically designated committees many other committees will participate more or less actively in the discussion of problems in connection with the Population and Agriculture Censuses. For example, some discussion has already taken place with members of the Business Statistics Committee of the United States Chamber of Commerce. A Committee on Census Statistics set up by the American Marketing Association under the chairmanship of Mr. Sidney Bernstein of *Advertising Age* has already discussed a number of problems which concern the Population Census. A number of agricultural publishers have established a committee to work with the Census Bureau in order to present their needs for certain types of information from the Census of Agriculture. Through a number of meetings of this committee a series of specific recommendations has been made which will be reviewed by the Technical Advisory Committee. The Committee on Social Statistics of the American Sociological Society is serving as a medium for transmitting suggestions to the Bureau of the Census. Space precludes the citing of additional committees, many of them inter-departmental in composition, which will participate in some phases of Census planning. In addition, some regional and local census committees have already been set up and more are likely to be established. Upon request, the Bureau will attempt to send representatives to meetings of such local groups.

It is hoped most of the suggestions concerning the 1950 Censuses of Population and Agriculture may reach the Bureau in the next few months while it is still possible to take them into account in preparing the budget. A variety of methods are available for the transmission of suggestions. Many of them will presumably come in the form of letters from individuals or organizations, addressed to the Director of the Census. Other suggestions will take the form of resolutions drafted by local planning groups or committees or of statements prepared by local chapters of national organizations. Whenever it is feasible for local sponsors of a change to discuss the proposals they have submitted to the Census Bureau with one of the members of the technical committees mentioned above it will usually be desirable to do so. In that way the committee member will have additional background information regarding local considerations which will be very helpful in connection with deliberations relating to the recommendations. The Bureau is soliciting suggestions for the 1950 Census from all interested users of census data. For example, invitations have already been sent to State Colleges of Agriculture and State Directors of Extension Service.

Illustrative problems in census planning

It may be worth while to give examples of a few problems which are likely to require considerable discussion on the part of the several committees. These are furnished both for illustrative purposes and in the hope that some comments may be stimulated from users of census statistics.

Continuation of Block Statistics. In 1940 a considerable number of housing items were published for individual blocks in cities of 50,000 or over. The cost of these tabulations, together with the accompanying maps, was quite substantial and was in considerable part met out of funds appropriated for work relief programs. It is necessary, therefore, to give careful consideration to the possibility that census tract tabulations could serve most of the purposes to which the block tabulations have been applied. Census tracts, already set up in 60 cities, with an additional number likely to be added in 1950, consist of small areas with a population of 3,000 to 6,000 people, so defined as to provide reasonably homogeneous subdivisions of the city. In reaching a decision on this matter, considerable weight will of course be given to evidence of actual uses of block statistics for purposes that could not have been served by census-tract figures.

Metropolitan Areas. A substantial demand exists for the development of a set of standard metropolitan areas for which the results of all censuses would provide statistics and for which many series of Federal and State statistics might also be supplied. In response to this demand an interdepartmental committee has been set up under the Bureau of the Budget to work on the subject. A considerable amount of intensive work has already been done by the staff of the Census Bureau and it is anticipated that some results will be available for public consideration in the next few months. Since county lines are the only feasible subdivisions for many types of data, it follows that the standard areas will probably be single counties or combinations of counties. The adoption of such a set of

areas for the use of the Population Census would mean that in the case of the larger cities figures would be provided for the central city, for the metropolitan district (including the central city plus primarily the minor civil divisions around the city with a population density in excess of 150 per square mile) and for the new metropolitan county area. It is to be noted also that work is being done on the definition of the highly urbanized fringe immediately surrounding the largest cities, as a result of which a new geographical area would be provided that would be more useful than the metropolitan district for certain marketing and analytical purposes.

Economic status of the population

There will doubtless be a demand for some general measures of the economic status of families and individuals in various areas. The following alternatives are being considered:

1. Wage or salary income of all persons and families, the approach used in 1940, but not entirely satisfactory in farming areas and in other areas where a significant number of the families have a large fraction of their income from sources other than wages and salaries.
2. Total income, including income from sources other than wages or salaries. The non-wage or non-salary income is difficult to obtain accurately for either individuals or families.
3. Total family income on a broad class-interval basis, the respondent being asked to specify which of a number of designated groups represents the closest approximation to his total family income.
4. Contract or estimated rent for all dwelling units (or value for owner-occupied units), an index less useful than formerly, since the relationship between rent (or value) and income for many families is greatly different from what it was prior to the war.

Labor-Force Questions. The planning of inquiries concerning the labor force will be made with due regard to the problem of international comparability. However, the comparability of 1950 U. S. Census statistics on working population with those of other countries cannot be determined definitely until we learn more about the plans of the other countries. It is possible that we shall find a trend toward more widespread adoption of the labor force concept, as would be suggested by the recently promulgated standards of the International Labour Office. In this area the Committee on the 1950 Census of the Americas of the Inter-American Statistical Institute has not yet adopted its minimum standards for the coordinated Western Hemisphere Census, but it is likely that the minimum standards agreed upon may be less elaborate than those required to produce labor-force statistics. However, in that event, a number of American countries may exceed the minimum requirements.

Definition of Farm Population. The Census Bureau has been using since 1920 essentially the same definition of farm population, by which farm population is defined as all persons living on farms, regardless of occupation. It is already apparent that an appreciable fraction of households living on tracts of land considered as farms has no member engaged in any form of agricultural activity. Despite an attempt to maintain the same definition, however, it is apparent that inconsistent results have frequently been obtained not only as between the Census of Population and the Census of Agriculture, but also from one Population Census to another.

It has been proposed that minor changes be made in the instructions to enumerators so as to produce greater uniformity and to standardize the actual field procedures. There is a possibility, however, that it may be preferable to make a more radical change and substitute for the population living on farms the population with some specified degree of participation in agricultural work.

Definition of a Farm. The definition of a farm has not been changed for several censuses. Changing agricultural conditions, changes in the price level, considerable variations among areas in the characteristic of places locally considered as farms, increase in part-time farming, and variation from census to census in the number of farms marginal in regard to the criteria established for determining the existence of a farm require a review of the definition used for a farm in the general census. Of course any modification in the definition of a farm may affect data for farm population and a number of other statistical series.

If I Were the Boss

by F. H. STERNS

Directly or indirectly, business butters the bread for most statisticians. The reader may supply his own proof of that assertion: it is made solely to emphasize the desirability of having business think well of statistical work, and of having statisticians cognizant of how they stand with business, and particularly with its top management.

This last might seem to call for a consensus of executive opinion. Thus a cross section of corporation presidents might be asked to check the statement most nearly in accord with their views:

The statistician is indispensable.
He has a certain ornamental value.
He isn't even good company.

If accepted, the results might be good for our souls, but I fear we would immediately dispute their accuracy, questioning perhaps the adequacy of the sample, the fairness of the question or the validity of the replies.

If we thus shy away from our own professional methods, we may still resort to the good old-fashioned pre-statistical plan of trying to put ourselves in the other fellow's shoes. We can pretend that one of us, say the writer, is the big boss who has to take all the risks, pay all the bills, and has the responsibility of making the business click; or, discarding the third person, that I am heading a new corporation, and am about to pick a production manager, a sales manager, and other department heads. Also a general counsel, a chief engineer, and perhaps other professional men to be equal in rank and pay to the department heads. Now suppose that you are my best friend; frankly, would you advise me to include a statistician in that top professional group?

Precedent certainly would be against that. In most business organizations, the statistician plays but a minor role. Too little use of his talents is made in planning and operating the business. Instead, his figures are used most often to support executive decisions, his charts to show to the outside world how well the business is doing and what a great business it is. Although the statistician's reputation for technical proficiency may be high enough, he is seldom considered a part of management. And in the few cases where he does take his place in the inner councils, it is noticeable that his title is usually something else than statistician.

Admittedly a part of the blame may fall on business, for its failure to recognize the value of statistics as a tool of management; but the point remains that statisticians generally have not sold management the idea that they possess professional qualifications equal to those of the lawyer or engineer. And in that adverse judgment, I as the boss, and you as my adviser, reluctantly must concur.

Just what do statisticians lack which these other professional men have? Can it be the ability, or the willingness, to take a definite stand? My statistician brings me the "facts" all right, beautifully tabulated or charted, but uncolored by any opinion of his own, and with their application left entirely to me. He will get the information upon which I or my top-level associates can act intelligently, but he will never, no never, usurp the executive prerogative. Secretly he may congratulate himself that he thus escapes "going out on a limb," as the department heads often must, but it is precisely this non-committal attitude that keeps him below the executive level.

Needless to say, the top professional men do not share his inhibitions. They do not avoid making decisions. Quite the contrary. Nor do they care whether I, as the boss, have all of the facts or not, although they may give them to me if my curiosity is that inordinate. They know they can interpret those facts better than I. Besides, that is their responsibility. So they tell me what to do or not to do; in effect ordering me around as if I were not the boss. And I like it. For I am sure they are thus acting as professional associates and not mere hirelings.

In spite of all this, I find that you as my adviser would still recommend a statistician for a place among the elect. And I can see your point. I have a job to be done which is at least as important as keeping me out of the clutches of the law or putting my trade-mark before the public. Without describing it all, I can say that one part of it concerns the future. Now it is a fact that my profits come largely from anticipating conditions ahead, and that every day some one in the organization must make a forecast, whether he realizes it or not. Any way of improving those forecasts is money in my corporate pocket. True, what is going to happen is "anybody's guess," but being an enlightened boss, I am convinced that there is a percentage in favor of having the guesses made by an expert.

This does not mean there will be a field day for chartists or extrapolatists. On the contrary, in my business I have no place for blind belief in trends, cycles, or other short-hand representations of ancient history. And the first person who gives me a mathematical projection of one such representation in place

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The Teaching of Statistics in England

REPORT OF THE ROYAL STATISTICAL SOCIETY

The material presented here is an abstract of the report on the teaching of statistics in universities and university colleges, presented by the Council of the Royal Statistical Society and printed in full in Volume CX, Part 1, 1947, of the *Journal of the Royal Statistical Society*. The report is based on the findings of the following committee: Chairman, E. S. Pearson; R. G. D. Allen; H. Campion; William Elderton; C. Oswald George; R. F. George; M. Greenwood; D. Heron; J. O. Irwin; H. Leak; E. C. Rhodes; R. Stone; L. H. C. Tippett; J. Wishart.

The need for professional statisticians

Most public discussion on statistics during recent months has brought out the need for the services of qualified statisticians. In their *Memorandum on Official Statistics*, the Council of the Royal Statistical Society recommended that the Civil Service should create some specifically statistical posts and recruit staff suitably qualified to fill them; they note with pleasure the recognition of the class of statistician at the administrative level in the Civil Service.

More recently the Committee on the Provision for Social and Economic Research under the chairmanship of the late Sir John Clapham have stated in no uncertain terms the importance of and the unsatisfied need for, statistics:

"We cannot leave this part of our report without some comment on the quite inadequate provision which at present prevails in universities in the United Kingdom for posts in statistics. An adequate supply of statistical competence is quite fundamental to the advancement of knowledge of social and economic questions. It is no less essential in public administration. Yet the number of chairs in statistics throughout the country could be counted on the fingers of one hand. It is small wonder that, during the war, statisticians were probably the scarcest of scarce commodities, and that, now the war is over, a chronic struggle is going on between the universities, business and the public service for the services of a supply of statisticians which is in the aggregate equal to only a tiny fraction of the demands immediately manifesting themselves, and still less of the demands which are certain to accrue as current policies develop and projected institutions are brought into being. There are few more urgent needs to-day than the increase of the supply of first-class statisticians. But this need will not be met if further provision is not forthcoming at the universities."

The advertisement columns of the press also bear witness to the demand by public and private bodies for statisticians to work in a variety of fields. It is known that in a number of cases in the government service, in the universities and in industry, it has been found impossible to fill these posts with persons having the qualifications desired.

The need for training in statistics as ancillary to other subjects

Equally important with the requirement for full-time professional statisticians is the need within the universities for instruction in statistical methods as tools ancillary to other subjects.

Social Sciences. Statistics is traditionally regarded almost as another term for quantitative economics, and most workers in all the social sciences find themselves from time to time in situations requiring a working knowledge of statistical methods and of what has been elsewhere termed "descriptive statistics" (e.g. the collection and interpretation of economic statistical data). Most university courses in economic and related subjects include a few lectures in statistics, but they do not all deal with the subject in a way we regard as adequate.

Biology and Medicine. A quantitative approach to biology in all its branches, pure and applied, is essentially statistical. Most quantitative laws are statistical in the sense of applying to groups rather than individuals, and a knowledge of the principles of statistical method is a powerful aid in the planning of experiments and the interpretation of their results. We are convinced that the time has come when all biological research workers, including those concerned with agriculture, should receive some training in statistical methods.

Chemistry, Physics and Engineering. Statistics has also invaded the so-called exact sciences of chemistry, physics and engineering. Modern theories of matter

have a statistical basis, and scientists have to free their minds from the limitation of thinking only in terms of individual things, exact laws, and unique quantities determined with perfect precision; they have to comprehend aggregates, statistical laws, and quantities subject to errors and variations that occur with various probabilities. Workers in the exact sciences, especially those who go into industry, often find that precise control of experimental conditions is, for one reason or another, impossible, and recourse must necessarily be had to statistical methods. It has often been found that experimentalists, trained only in the "classical" methods of the exact sciences, are baffled in this situation; sometimes when they have turned to statistical methods for aid, they have done so without adequate study and with a naïveté that has rendered their work ineffective. The only corrective for this is an adequate training in the fundamentals of statistical methods.

In recent years, too, special statistical methods have been developed for the control of quality in production in the chemical and engineering industries. We consider that statistical methods applied to engineering investigation and processes should be developed as a subject for instruction to students in engineering departments; further, that this recommendation should be extended to chemistry and physics. We do not expect that the authorities will insist on all students in these three faculties studying statistical methods to the level we have in mind here, and for the time being would be content with an extension to more universities of the special or post-graduate courses, now given in some universities and available to selected students.

The scientist working in any field should not only be his own statistician for everyday purposes, but when he needs to consult the professional statistician he should remain in control, postulating the problem and examining the solution critically. Although it is the duty of the professional statistician to learn enough of the field of application, co-operation will be satisfactory only if the experimental scientist also appreciates the statistical approach and has learned something of statistical methods.

The need for a more widespread knowledge of the statistical approach

In the social and natural sciences, for every worker who has need to use statistical methods, many have occasion to appreciate results and arguments having a statistical basis. It is strongly urged that all students in these sciences should have some familiarity with statistical ideas and the most common methods, as part of their background knowledge.

This point is stressed also because, in the Council's view, the statistical approach is so fundamental to the modern way of looking at things—the affairs of everyday life as well as scientific theories and experiments—that it should form part of the mental equipment of the educated man, which it is not at present. Most people, whether their formal education finishes at school or the university, when they think quantitatively and scientifically, do so in terms of the conceptions of "classical" physics. When they have to adopt a statistical viewpoint, a conscious and often difficult mental reorientation is required.

Sir Charles Darwin, in his Presidential Address to the Mathematical and Physical Sciences Section of the British Association in 1938, expressed the hope "that generations will grow up which have a facility that few of us at present possess in thinking about the world in the way which the quantum theory has shown to be the true one. The inaccuracies and uncertainties of the world will be recognized as one of its essential features. Inaccuracy in the world will not be associated with inaccuracy of thought, and the result will be not only a more sensible view about the things of ordinary life, but ultimately, as I hope, a fuller and better understanding of the basis of natural philosophy."

We share that hope, and think it may ultimately be realized through the teaching of statistics in schools; but until this is done there is an added responsibility on the universities to supply a lack in the mental equipment of their undergraduates, and to provide the next generation of schoolteachers with the right background. We do not propose at present that universities should attempt to fill this gap in general education, but in so far as they do so for special reasons in the case of all students in the sciences mentioned, they will be contributing to the general dissemination of statistical ideas and methods and to their full assimilation into the educational curriculum.

The need for schools of pure statistical teaching and research

The need for practising statisticians is apparent, whether in the Civil Service, in the professions, in industry, or as university teachers; the importance of giving a training in statistical method to students in all scientific subjects is being increasingly recognized. These requirements carry with them, however, the less apparent but fundamental need for schools of statistics, where the subject is studied for its own sake, where research is carried on, and where teachers gain knowledge and experience. In statistics, as in other subjects, a profession of general practitioners requires the support of an inner circle of specialists, research workers and teachers; and the inner circle maintains its strength partly through teaching and serving the general profession. It is in the university tradition to treat subjects in a broad and fundamental

way so as to satisfy the needs as we have stated them; and for this reason we are strongly of the opinion that the teaching of statistics at the professional level should be largely in the hands of the universities. Where this advanced teaching can be associated with an important research school of statistics, considerable advantage will follow.

Some universities have developed or are developing advanced schools of this kind. The demand would not justify the existence of such schools at all universities. . . . We do, however, suggest that statistics should in all universities be one of the applied courses for a mathematical degree.

The types of university courses

The preceding analysis leads to the conclusion that there should be three main types of course. These will be discussed in the paragraphs of the present section, while comments on the forms of organization required to achieve this programme will be made . . . (later).

Elementary courses. At the lowest level there should be general courses designed to familiarize students with statistical ideas and the most commonly used elementary methods. These should be given in all universities, and should be part of the ordinary undergraduate course of at least all students in the social and natural sciences. The courses need not be very long (10 lectures may well be enough), nor need they require any special mathematical ability; but they should contain some practical work, for practice in the use of statistical methods is a great help to understanding them.

Courses of this kind are necessary largely because there is at present little teaching of statistics in schools. If such teaching is extended these university courses could be modified and, ultimately, they may even be abandoned as unnecessary.

Ancillary courses. According to the present analysis, courses of a somewhat more advanced type are required to enable students to utilize properly statistical methods as developed for application to their chosen science. It is suggested that the syllabus should be designed to teach fully the use of the most commonly employed methods special to the science, and sufficient of their basis to show their limitations; further, it should deal with more advanced methods sufficiently to enable students to recognize when a problem should be referred to a statistician, to co-operate in its solution, and to understand the result. It seems inevitable that there should be separate courses for groups of students specializing in the various sciences. The necessity, at this level, of supplementing lectures by practical work cannot be too strongly emphasized.

We believe that it is desirable that this second type of course should be taken by most students of the social and biological sciences in all universities, as part of the normal curriculum for a first degree. . . . It is impossible to escape the conclusion that the scientific worker in the social and biological fields who has not a sound grasp of the statistical approach and its simpler methods of application, is seriously handicapped when appreciating quantitative laws and attempting the interpretation of observational data.

As things stand at present only some of the students of physics, chemistry and engineering will wish or need to take statistics beyond the elementary level, and their requirements will probably best be met by providing in more universities postgraduate courses of the kind now available in some places.

Advanced courses. Advanced courses are probably not required at all universities. Where given they do and, we think, must, vary in scope and method. At present the University of London is alone in offering a bachelor's degree in statistics, but even in London there is no uniformity in practice at the different schools of the University, and here, as elsewhere, advanced statistics may be included in the undergraduate syllabus within the faculties of mathematics or economics.

It is clear that any scheme of training statisticians must include the provision of postgraduate courses. Apart from reasons for this, which apply equally to any subject of study, there are certain special reasons holding in the field of statistics which will be referred to in the following paragraphs.

The basis of statistical theory and its ally, the theory of probability, is essentially mathematical. Thus, whether a university provides advanced courses in statistics at the undergraduate level or not, a considerable number of graduates with a first degree in mathematics are likely to be attracted to the subject. It is these students, with others of a mathematical bent, who have learned statistical methods in their undergraduate period, who will form the recruits to the main body of mathematical statisticians who carry on the subject by teaching and research.

In certain cases, courses should be organized which, while dealing adequately with statistical theory and method, will aim at treating the application to some special field in an advanced way. In this connection consideration might well be given to the development of arrangements whereby suitably qualified students can gain practical experience during the long vacation in the surroundings under which real problems must be solved, whether in industrial establishments and research laboratories or elsewhere.

Courses for extra-mural students. We would call attention to the thousands of persons, whether gradu-

ates or not, who have passed beyond the university stage, and are now at work in this country without having received any training in statistics. As is known from inquiries that have been received, many of these persons are realizing the need for such a training. We ask the universities to consider taking what steps they can to meet this need by establishing short intensive whole-time or part-time courses, which graduates and others already in employment can attend. In large towns such as London this is being done by the arrangement of evening courses.

Examinations and diplomas. It is necessary to refer only briefly to the subject of examinations and diplomas. The Council are concerned that all statistical work should be done competently and, as a corollary, the employers should be discriminating in their choice of the people who are to do it. A mark of proficiency in statistics is an aid to this, and it is hoped that all universities which give special courses in the subject will also test the proficiency of their students and mark or give diplomas accordingly.*

The organization of the teaching of statistics

On the organization of the teaching of statistics in universities we do not presume to do more than raise some general points.

It is strongly recommended that the main teaching in the subject should be the sole responsibility of one or more senior members of the staff, professors or readers, and this for two reasons. First, it is important that statistics should have proper status in the university scheme of things and statistical interests due weight in university counsels. Second, it is essential that the teaching shall be in the charge of men of first-rate ability, highly qualified, able to do original work, enthusiastic for their subject, and willing to make its teaching their career. University teaching in statistics, as in all subjects, should be more than a retailing of second-hand knowledge; its teachers should do original work as well as teach, even where there is no advanced or research school, and the universities should be able to attract their share of the best men in the profession. This they will achieve only if the top posts are commensurate in status with those in other main subjects.

A question which has to be faced is whether the teaching of statistics should be centralized in one department or section. It seems indisputable that the teaching of various special branches such as economic "descriptive" statistics, vital statistics and statistical mechanics should be distributed among the appropriate departments. The main principles of statistical theory, the essential elements of probability theory and their methods of application are, on the other hand, basically common to all subjects of application, and there are therefore arguments for and against having them taught centrally.

Centralization will tend to give statistics due status in the university. If the teaching is scattered among many departments the subject is apt to be lowly regarded, and the students think it something of a nuisance to be tolerated purely for examination purposes. The right spirit is attained if the teaching is done by authorities in their subject with an enthusiasm for it, and in an atmosphere where statistics matters and is seen to have a life of its own. Moreover, so much of statistical methodology is common to all subjects of application that some centralization is economical; and this argument is specially cogent at this time when qualified teachers of statistics are scarce. Further, the application of statistics in one subject gains from experience of its application in another (many of the methods used in chemical, physical and engineering research came by way of agriculture), and a splitting-up of the teaching is apt to produce sterility in the subject. Students of various faculties who join to attend common statistics lectures also come, incidentally, under the broadening influence of contact with sciences other than their own.

On the other hand, centralization, if carried too far, brings with it the danger that the statistical teaching may lose touch with reality. It is important, too, that the statistical way of thought should permeate to the other departments, and that students should not regard it as a kind of special mental gown, to be worn when in the statistics department and discarded on return to their own.

The situation calls for compromise, experiment, and variation in treatment. We suggest that each university should establish a recognized centre for statistical methodology. In it could be given all the elementary courses, all the advanced courses on general theory and method, and some of the more special applied courses, particularly those at our proposed second level of advancement. In addition, the separate faculties could have their own statisticians and do some teaching, particularly of special applications. For example, we imagine that all economics and related departments will need their own staff to deal specially with such subjects as index numbers, the analysis of

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* The Royal Statistical Society has recently authoried its Council to cause examinations to be held for the purpose of testing the statistical proficiency of such Fellows of the Society as may desire to submit themselves for examination, and it is hoped that such examinations will shortly be instituted. Every successful examinee will receive a certificate stating the nature of the examination which he has passed. (*Editors Note:* An article by M. G. Kendall dealing with the examination system will appear in the April issue of *The American Statistician.*)

Statistical Control of Accidents

by J. M. HOWELL and LEE JOHNSON
Quality Control Engineer and Safety Engineer respectively, Northrop Aircraft, Inc., Hawthorne, California

Reprinted by special permission of "The Iron Age", this article describes how the statistical method used in control of product quality can be used as a technique for the control of accidents. Preliminary studies of this new approach indicate that it will aid materially in reducing accident rates, the authors declare.

Statistical methods have been used to control the quality of manufactured products for several years. Such characteristics as dimensions, weight, hardness, and others have been controlled by the use of charts. The control chart technique has also been successfully applied to many problems other than manufacturing. One of the most interesting of these has been the application to the control of accidents and, from preliminary study, it appears that this application will aid materially in reducing accidents.

In order to show what has been done in this application, it will be necessary to point out some simple aspects of statistical theory. It has been found that, when measurements are made on the height of men, length of leaves on a tree, or dimension of a part, many of the measurements fall near the average of all the measurements, while toward the extremes of the distribution are relatively few measurements, as indicated, Fig. 1A. In fact, it is found that, in many cases, these measurements will be very near a certain mathematical curve which is called the normal curve. The normal curve has a mathematical formula which may be expressed in terms of two constants, the average and the standard deviation. When these two constants are known, the curve may be drawn as shown in Fig. 1B.

If the measurements are expressed in terms of the standard deviation (σ) units from the average, it is possible to determine the approximate percentage of measurements lying within given distances or limits:

Limits	Percent of measurements
$a \pm 2\,\sigma$	95.5
$a \pm 3\,\sigma$	99.7

Several statistical distributions approach the normal distributions and the theory of the normal distribution is used to determine limits for most control charts.

The unit used in control of accidents is the number of injuries reported per 1000 manhours worked. The number of reported injuries includes the total count of all first aid, medical (cases seen by doctors), and

Fig. 1 Two aspects of statistical theory applied to accident control

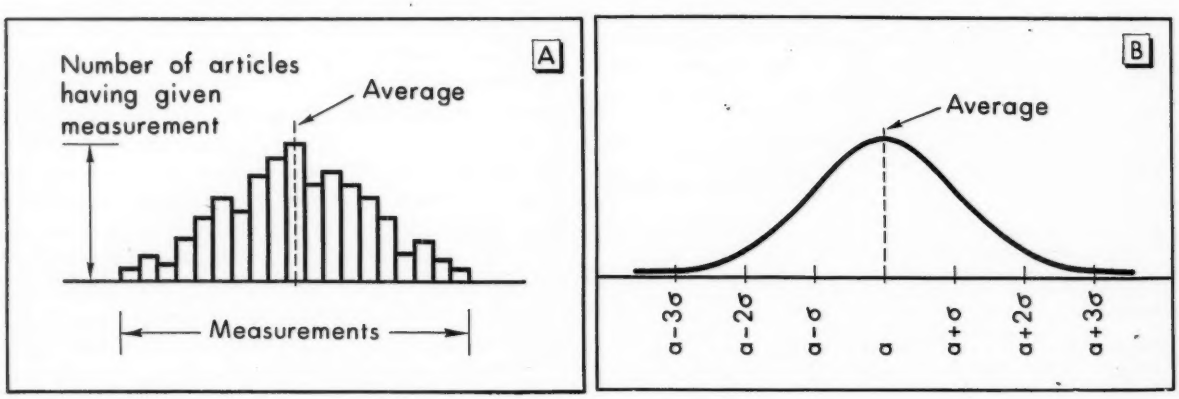
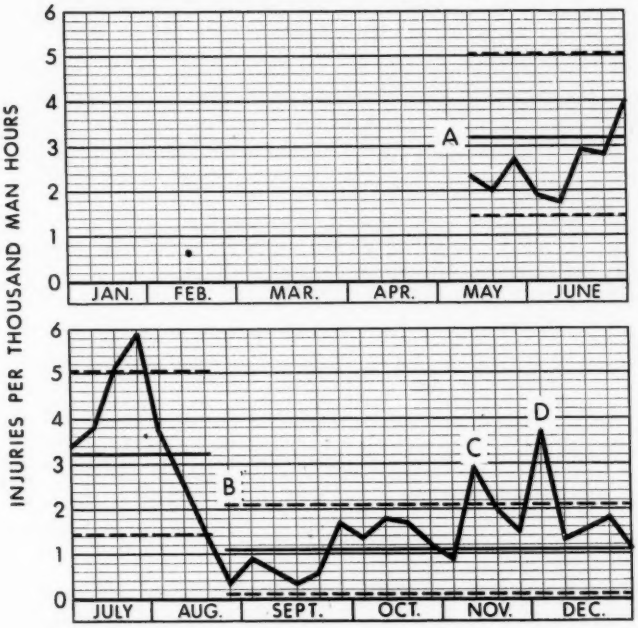


Fig. 2

WEEKLY QUALITY CONTROL CHART

DEPARTMENT #14-PRODUCTION EXPEDITING YEAR 1945

NUMBER OF INDUSTRIAL INJURIES PER THOUSAND MAN HOURS DATA BY LEE JOHNSON



REMARKS

A. AVERAGE	3.20
UPPER LIMIT	5.00
LOWER LIMIT	1.40
B. AVERAGE	1.10
UPPER LIMIT	2.10
LOWER LIMIT	0.10

C. CHART OUT OF CONTROL DUE TO EMPLOYEES NOT WEARING SAFETY GLASSES AND OTHER PROTECTIVE CLOTHING WHEN WORKING WITH PAINT REMOVER

D. THE INCREASE IN WORK INJURIES WERE CAUSED BY UNSAFE WORK PRACTICES SUCH AS LEAVING MATERIAL AND EQUIPMENT WHERE IT CAUSES A TRIPPING HAZARD.

lost-time injury cases. Lost-time injury cases mean that the severity of the injury has caused the injured employee to miss more than one day of work. For example, if in a given department there were eight accidents for one week, and 4000 hours worked in that department for the period, then the rate would be 2.0 accidents per 1000 manhours. The next week the rate might be 2.5 injuries per 1000 manhours. After several weeks have elapsed, an average is determined. On charts that are placed in the shop the average, or central line as it is called, is placed at $\bar{c}$. The limits are:

$$\bar{c} \pm 2\sqrt{\frac{\bar{c}}{\bar{n}}}$$

when $\bar{n}$ is the average number of units for the period on which the average is calculated. In the case of accident charts, the units are injuries per 1000 manhours and the average number of units is the average number of 1000 manhours.

An example of a chart of this type which is posted in the shop is shown in Fig. 2. Since this chart is in plain sight, supervisors and the workers can see at any time what the safety record is, and can see any significant changes. An example of the instruction and explanation sheet which is posted with each shop chart is shown below the chart, Fig. 2.

The charts were first posted in the shop in November. Data prior to that time were analyzed and plotted, but no corrective action was taken on this past data. The limits used in these calculations may be revised at any time that the conditions of operation or the number of men working in a department change considerably.

CONTINUED ON PAGE 19

QUESTIONS and ANSWERS

edited by FREDERICK MOSTELLER
Harvard University

LOGARITHMIC TRANSFORMATION

Question 6. In the analysis of the heterogeneity of variance by use of the logarithmic transformation, how is the theoretical variance computed for testing the significance of the residual variance?

Answer. I take it you are referring to the analysis described by Bartlett in the Supplement to *The Journal of the Royal Statistical Society,* 8: 128, 1946.

The quantity you want is what Bartlett has given as κ_2. The exact value is the trigamma function of $n/2$, which you will find tabled by Davis, also in British Association Tables, Vol. I, and in Pearson's *Tracts for Computers, No. I.* As Bartlett points out, for n greater than 6, an approximation to better than 1% is given by

$$\kappa_2 = 2/(n-1)$$

You should, of course, note that this value applies to the natural log, and if you are using logs to base 10, you must multiply by $(.4343)^2$.

Charles P. Winsor

ACTUARIAL TRAINING

Question 7. What universities or colleges specifically attempt to prepare students for actuarial work either as undergraduates or graduates?

Answer. To the best of my knowledge, a reasonably complete program in actuarial work is offered on this continent by only the following five schools: the Universities of Iowa, Manitoba, Michigan, and Toronto and Drake University. The last named school is a relative newcomer to the field, having instituted its program in 1946. There are a few other institutions which offer some work along this line (beyond the conventional undergraduate program in mathematics), such as courses in finite differences, probability, and elementary mathematics of life insurance. Of course, many colleges offer courses in mathematical statistics, which is one of the subjects required.

The complete program at the University of Michigan includes the following courses beyond the calculus, in the Department of Mathematics:

Mathematics of Finance
Elementary Mathematics of Life Insurance
Finite Differences
Probability
Mathematical Statistics
Topics in Actuarial Mathematics
Intermediate Mathematics in Life Insurance
Advanced Theory of Interest and Life Contingencies
Mortality Studies
Life Insurance Accounting.

In addition to these courses, the student is encouraged to take courses in economics, accounting, investments, and life and property insurance in the Department of Economics and the School of Business Administration.

(*Editor's Note:* We would be glad to receive additional information on this subject.) C. H. Fischer

A MATCHING PROBLEM

Question 8. I have collected Rorschach data on subjects from four different cultures, A, B, C, D. I have six cases from each of the four cultures. I am interested in seeing whether a Rorschach expert can by "blind" analysis classify subjects to their cultures on the basis of the test results. I have given the expert three Rorschachs from each culture, telling him which culture each came from, but not telling him the name of the culture, only the letter designation. I have also given him the other 12 Rorschachs and asked him to classify each as A, B, C, or D, but telling him there are three of each. My question is—How many must my expert get right before I should believe he is doing better than chance?

Answer. Your Rorschach expert will probably have considerable difficulty generalizing about the whole culture on the basis of a sample of three because individual differences within cultures may be expected to be rather large. I would guess that they would dominate the differences between cultures on the ordinary Rorschach variables. We have no very good way of taking account of the fact that three subjects chosen to typify the culture may be either non-representative, or merely inadequate.

The problem posed seems to be a special case of the general card matching problem. Assuming that the expert has no ability to classify the subjects, it is as if we had laid out in a line a target deck of cards composed of 3A's, 3B's, 3C's,

and 3D's. We have a second set of cards of the same composition which we shuffle thoroughly. Then we lay out the second deck of cards beneath the first and count the number of times target cards are matched by those from the random (shuffled) deck. The distribution of the number of matches is quite tiresome to compute, although the method is straightforward, and I do not know of any place where the distribution for the particular deck you inquire about is tabulated. However, the mean and variance of the distribution are fairly simple when the target deck is identical with the shuffled deck. The mean number of hits is given by

$$E(h) = \sum_i \frac{n_i^2}{n},$$

where h is the number of hits, n is the number of cards in a deck, and n_i is the number of identical cards in the ith suit. In the present example $i = 1, 2, 3, 4$, $n_i = 3$, $n = 12$. Furthermore the variance is given by

$$\sigma_h^2 = \sum_i \left[\frac{n_i^2}{n} - \frac{n_i^4}{n^2} + \frac{n_i^2(n_i-1)^2}{n(n-1)} \right] + \sum_{i,j} \frac{n_i^2 n_j^2}{n^2(n-1)}.$$

For the problem at hand, since all the n_i are equal to 3 the mean number of hits will be

$$E(h) = 4(3^2/12) = 3$$

and the variance will be

$$\sigma_h^2 = 4[3^2/12 - 3^4/12^2 + 3^2 2^2/12(11)] + 12[3^2 3^2/12^2(11)]$$
$$= 27/11$$
$$\sigma_h = 1.57.$$

Now although we do not know the exact distribution and we do know that it is rather sharply skewed, we still might be willing to make our decision on the basis of standard deviations rather than on a computed probability because of the labor involved. No one can tell you what significance level to set, but if we arbitrarily take two standard deviations from the mean as our criterion, the decision point will be $3 + 2(1.57) = 6.14$. Since there has to be an integral number of hits, it would then be reasonable to decide to reject the null hypothesis if the expert obtains 7 or more correct answers. For further information on this subject see S. S. Wilks, *Mathematical Statistics*, Princeton University Press, and references cited therein.

STATISTICAL CONTROL OF ACCIDENTS CONTINUED FROM PAGE 17

One might think that there would be a tendency for employees not to report injuries in order to make their chart appear better. This has not been the case, for during the period November to February the total number of injuries have been rather stable, but lost-time injuries have been reduced by approximately 50 percent and medical cases have been reduced by approximately 35 percent. A series of management charts is made up monthly and distributed to management and supervision. These charts show the number of accidents and rates by division and department. In order to show all departments with varying rates on the same scale, the following absolute measure is used:

$$t = \frac{c - \bar{c}}{\sqrt{\frac{\bar{c}}{n}}}$$

where c is the rate for the given week, $\bar{c}$ is the average rate over the base period and n is the number of 1000 manhours for the given week. The values plotted on the management charts are then "t" values with the center line at 0, the lower limit at -3, and the upper limit at 3. By this means, departments with different rates may be compared and all departments may be shown on the same type of scale. In addition to the data shown on the management charts, appropriate comments are also shown, to explain any irregularities and to point to correction of undesirable conditions. In general, these comments should be short and specific. Self-explanatory items should be used very seldom, and then only for emphasis.

It will be noticed that the normal ratings were changed in almost all divisions and departments after V-J day. This was done because conditions changed appreciably. After V-J day, there were fewer inexperienced and female employees than before. The relaxation of wartime pressure on employees and supervision has allowed them to pay more attention to safety. The normal level in one department was also changed during November since the number of employees was changed about five-fold, and conditions were appreciably changed.

Some of the advantages of the use of quality control techniques as here applied to control of accidents are as follows: (1) Management, supervision, and workers are aware of their accident rate and strive to lower it; (2) variations of such nature as to be significant are quickly noticed and corrective action may be taken; and (3) minor variations which are not significant may be safely disregarded.

TEACHING OF STATISTICS CONTINUED FROM PAGE 15

economic time series, and the special problems of sampling in the social and commercial fields; some strong departments of applied biology may profitably employ their own staff to deal with biological experimentation; and some engineering departments may find it advantageous to employ a specialist in engineering and industrial statistics.

Whatever the degree of centralization, some statistical work will doubtless be done in several schools or departments of any one university, and the appointment of a joint committee or board of studies to secure co-ordination and co-operation appears essential. This could include representatives of departments that merely use statistical methods as well as of those that teach them.

Clearly where an important school for training and research in statistics exists or is planned, it should form an autonomous department. Elsewhere the statistics centre will need to be attached to an existing department, and we think that this should be the mathematics department. Mathematics is at the root of the theory and methods of statistics; moreover, the relation of statistics to other scientific subjects is very like that of mathematics, and similar organizational relationships are appropriate.

We have already stressed the importance of practical work as a part of training in statistics, and again emphasize the arithmetical basis of the subject. Unless the student has himself applied the technique developed in lectures to numerical data, the instruction he has received may be largely wasted effort. It is therefore essential that teaching facilities should include statistical laboratories, equipped with computing machines, and fully adequate both for the training of students at the lower levels and for the prosecution of such research as is undertaken.

Inter-university co-ordination

We are concerned that the standard of teaching and examination in statistics should be uniformly high in all universities, but think that this can be secured through the normal intercourse that occurs between universities, as by exchange of staff and employment of external examiners.

IF I WERE BOSS CONTINUED FROM PAGE 11

of a measured judgment goes out of my office on his ear. But anyone who has learned the fundamental lesson of the theory of statistics—how to get sound conclusions from faulty or even fragmentary data—can have the run of the place. And the full professional accolade will go to him who by complex mathematical analysis, or just plain intuition, arrives at an understanding of why things are as they are and whether the forces at work will result in a future the same as or different from the present.

The service my statistician will render will be tailor-made, just for me. He will never bring me a national volume of production forecast, even if he has made one for his own use; for it would still need to be translated into the language of my business, and in my organization the statistician will do his own translating. But he may tell me that I should look for greater sales resistance next month or next year in the particular group of people who are or who might be my customers. Again, he will not burden me with the sociological or economic characteristics of a proposed market when what I want to know is how much I can sell there. Needless to say such specific forecasts are much more complex and require much more judgment than the more generalized ones do. They are distinctly not for run-of-the-mill statisticians; and so, after all, maybe I should give my professional statistical associate some other title.

I note that my statistician likes to hobnob with economists, sociologists, and the like. That is all very well. He will need all the help they can give him. But in addition to his contacts with the learned societies, perhaps he should explore the common interests he may have with the bar association, the medical society, the engineers' club, and other professional societies which like himself are serving business. Especially the American Management Association.

One thing more. If I tell my statistician to get me figures to prove a certain point, and unprotestingly he does just that, it is time for me to question his value. I know that I am a difficult person to handle when I am crossed, and that "go-getting" is an approved business philosophy, but somehow I do not expect a statistician to be a yes-man. If there is ever to be a profession of statistics in business, with a code of ethics as other professions have, the cornerstone of that code must be intellectual honesty.

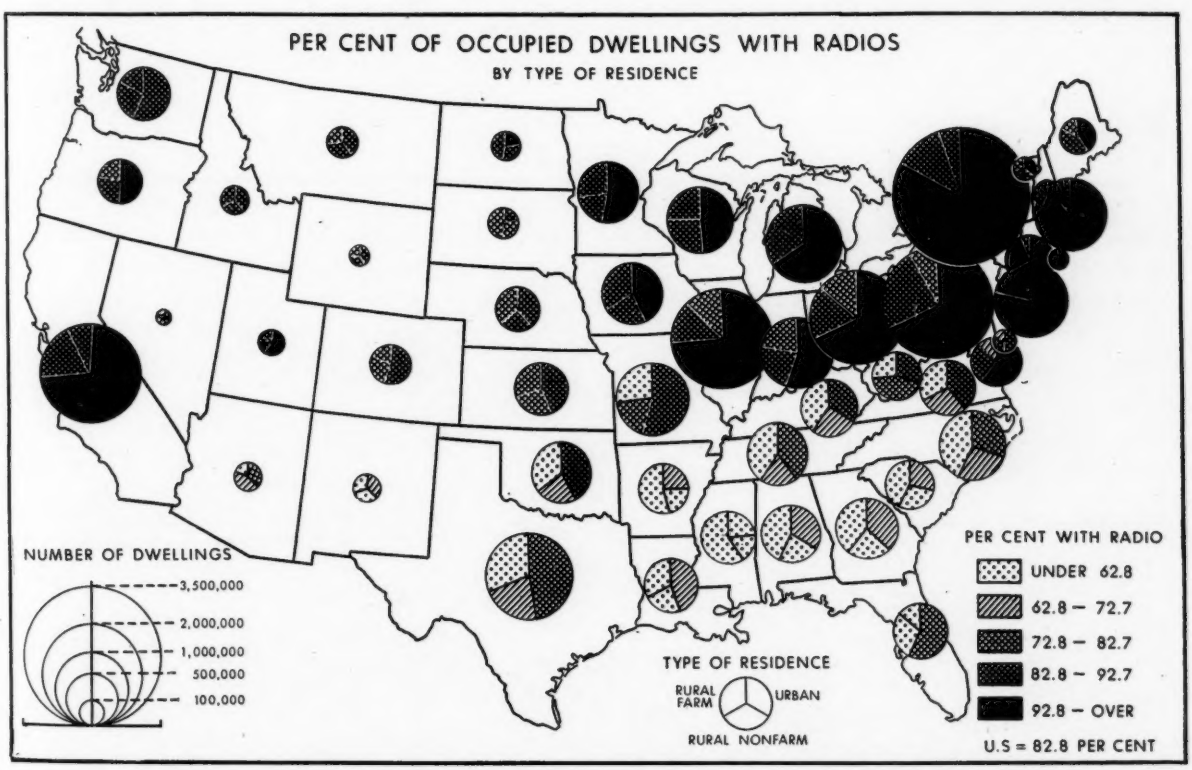
Three-Factor Cartographic Representation

by HOMER L. HITT
Louisiana State University

The conventional shaded statistical map has one fundamental weakness. The shading of the geographic divisions emphasizes their surface areas rather than their statistical populations under study. Since there is no uniform relationship between the two, erroneous and distorted concepts of the relative importance of conditions prevailing in a division are often conveyed. When large divisions are in fact sparsely populated and small divisions densely populated, as is often the case, the visual impression is, of course, seriously misleading.

Researchers sometimes eliminate this "surface-area" bias by supplanting the geographic divisions as the units for shading with some form of area diagram. Circles, with areas proportionate to one of the variables under analysis, seem generally suitable for this purpose. Their use not only removes the surface-area bias, but also permits the simultaneous consideration of two pertinent factors instead of one. For example, the distribution of radio ownership by states might be presented by showing in each state a circle proportionate in area to the number of dwellings and shaded to represent the percentage having radios. Such a two-factor representation is analytically superior to the two conventional shaded maps which it replaces.

Spatial variation of many phenomena is influenced by more than one basic factor. In the distribution of radio ownership, for example, type of residents as well as number of dwellings has an important effect. Even in the two-factor type described above, the question remains unanswered as to whether observed differences are actually geographic differences or are merely reflections of the varying proportion of rural and urban residents in the population. To solve such a three-variable problem, the analyst ordinarily resorts to a multiplication of conventional one-factor maps. The use instead of a series of two-factor maps, although more advantageous, also requires of the reader the difficult and



THREE-FACTOR CARTOGRAPHIC REPRESENTATION CONTINUED

frustrating task of referring back and forth between maps.

However, the multiple-map approach to three-factor graphic analysis has been outmoded by a recently developed technique.[1] This new device involves merely the use of position of sectors within the circles on the two-factor map to identify a third factor. In applying this technique, the circles are divided into sectors representing components of the whole. The divisions start from the same point and follow the same sequence throughout the map. Circles divided in this manner differ from conventional pie charts in that position rather than shading of the sectors indicates their identity. The shading performs the primary task of showing approximate values of the index under consideration for the groups represented by the sectors.

This ingenious technique, which enables the adept handling of three factors on the same map, greatly facilitates the analysis and presentation of many types of statistical data. For example, if concerned with the relationship of residence to radio ownership, this technique permits showing on a single map the geographical distribution of the total dwellings (the sizes of the circles), the absolute and relative importance of the urban, rural-nonfarm, and rural-farm dwellings (the sectors of the circles) and the variations in percentages of dwellings with radios (the shadings of the sectors). (See map on facing page.) This map reveals where a residential differential exists; if present, the nature of its spatial distribution; and, finally, whether geographical differences independent of residential make-up exist. In a similar manner, racial composition or any other controlling factor may be used as a basis for classification in three-factor map representations.

Along with economy and analytical superiority, simplicity of preparation and interpretation must be included among the advantages of this three-factor presentation. Incidentally, a minimum of seven strictly one-factor maps would be required to represent the imposing collection of information contained in such a map.

[1] Developed by T. Lynn Smith and J. Allan Beegle in population research at Louisiana State University.

NEWS CONTINUED FROM PAGE 5

Spare reprints and technical volumes needed by European Scholars

A number of requests have been received by the ASA office from European scholars asking for reprints of articles or spare periodicals and publications on economics and statistics which have appeared during the war. Your spare copies will be kept on file for distribution to European scholars who request material. Address to 1603 K St., N. W., Washington 6, D. C.

Last Six OPA War Profits Studies published

The last six monographs of the *OPA War Profits Studies* have been published by the now defunct Office of Temporary Controls. A limited supply is available on application to The Publications Section, Division of Liquidation, Department of Commerce, Washington 25, D. C.

Monographs 16–18 in general supersede monographs 10–12, which were published in 1945, a small supply of which also remains available through the same office. The concluding studies of the series, including Nos. 10–12, are as follows:

CORPORATE PROFITS, 1936–39–1944

No. 10 Part I: *1936–39–1942—Industry Expanding for War*

No. 11 Part II: *1943—Industry Adjusting to Full War Load*

No. 12 Part III: *First Half 1944—Industry Stabilized at Wartime Peak*

No. 13 *War Contractors' Profits, 1936–39–1944*

No. 14 *Profits, 1936–1944, of 520 Food Processors*

No. 15 *Profits, 1936–1944, of 326 Textile Manufacturers*

CORPORATE PROFITS, 1936–1946

No. 16 Part I: *1936–1944 (Annually)—Profits Growth to Wartime Peak*

No. 17 Part II: *1936–39 and 1942–45 (1940–1945 Annually)—Wartime vs. Peacetime Earnings*

No. 18 Part III: *Half-Year Earnings — 1936–39, 1942–45, 1945, 1946—Impact of Reconversion*